WEPAWAUG RIVER FLOOD CONTROL
MILFORD AND ORANGE
CONNECTICUT

HYDROLOGIC ANALYSIS
FOR
EXPANDED RECONNAISSANCE
STUDY

BY
HYDROLOGIC ENGINEERING SECTION
WATER CONTROL BRANCH
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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

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HYDROLOGIC ANALYSIS
FOR
WEPAWAUG RIVER EXPANDED RECONNAISSANCE STUDY

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MILFORD AND ORANGE, CONNECTICUT
HYDROLOGIC ANALYSIS

1. PURPOSE

This report presents the hydrologic analysis pertinent to a reconnaissance level study for flood control on the Wepawaug River, principally within the limits of the city of Milford and the town of Orange, Connecticut. Included are sections on watershed description, streamflow data, analysis of the June 1982 flood, and hydrologic engineering features of various plans of improvement.

2. WATERSHED DESCRIPTION

The Wepawaug River, located in southwestern Connecticut, has a watershed area of about 19.8 square miles. It is a coastal watershed, elongated in shape, with a total length of about 11.5 miles and a maximum width of about 2.7 miles. The Wepawaug River originates in the town of Woodbridge, Connecticut in the proximity of Peck Hill near the Woodbridge-Seymore town line and flows in a southerly direction, a total distance of about 11.5 miles, through the towns of Woodbridge, Orange and Milford, where it discharges to Long Island Sound. Of the total drainage area, about 15.0 square miles lie upstream of the Orange-Milford town line and about 8.0 square miles lie upstream of the Woodbridge-Orange town line. The Wepawaug River has a total fall of about 460 feet in its 11.5 mile course of which about 126 feet are in the 3.6 miles through Orange and about 57 feet in the 3.0 miles through Milford. At the mouth of the Wepawaug River (New Haven Avenue) there is an existing 16-foot high dam which separates the river from tidewater in Long Island Sound. A delineation of the Wepawaug River watershed is shown on plate 1.

3. STREAMFLOW RECORDS

There are no continuous long term discharge records for the Wepawaug River. The US Geological Survey (USGS) has maintained a

TABLE 1

WEPAWAUG RIVER
PEAK DISCHARGES AT WALNUT STREET GAGE
(D.A. = 18.4 square miles)

Date	Stage* (feet)	Peak Discharge (cfs)
12 March 1962	5.17	970
6 March 1963	4.71	800
25 January 1964	3.88	350
8 February 1965	3.79	340
13 February 1966	3.79	340
17 April 1967	3.90	350
29 May 1968	3.79	340
23 April 1969	5.46	530
4 April 1970	5.89	580
14 September 1971	4.07	380
19 June 1972	6.56	1,300
2 February 1973	5.70	900
21 March 1974	5.45	810
3 April 1975	3.59	320
28 January 1976	5.12	700
22 March 1977	4.53	530
26 January 1978	6.17	1,100
29 January 1979	7.24	1,600
10 April 1980	7.00	1,500
21 February 1981	3.44	300
6 June 1982	9.89	5,000

*Datum of gage 31.6 feet NGVD

peak discharge gage on the river, just downstream of Walnut Street bridge in Milford, Connecticut, since 1962. The greatest flow measured at the gage was about 5,000 cfs, experienced in June 1982, which was more than three times the previously measured flood of record of 1,600 cfs, experienced in January 1979. The drainage area of the Wepawaug River at the gage is 18.4 square miles. Annual peak flows measured at the gage are listed in table 1.

4. JUNE 1982 FLOOD

a. Rainfall. The greatest known flood on the Wepawaug River occurred in June 1982. This flood resulted from a "northeaster" storm that settled over southern New England in the early evening of 4 June. The storm produced approximately 10 inches of rainfall over the Wepawaug watershed during the period of 4-6 June with 7.0 inches measured on the 5th. Daily storm rainfall data, as measured during the June 1982 flood at the New Haven, Connecticut US Weather Bureau precipitation station (non-recording), located approximately 8 miles northeast of Milford, is listed in table 2. Also listed in table 2 are rainfall amounts, by periods, furnished by the town engineer of Wallingford, Connecticut.

TABLE 2

DAILY PRECIPITATION
NEW HAVEN, CONNECTICUT
STORM OF JUNE 1982

Date	Rainfall (inches)
4 June	0
5 June	7.0
6 June	3.0
7 June	0

WALLINGFORD, CONNECTICUT

Period	Rainfall (inches)	Total (inches)
4 June, 8:30 AM - 5 June, 9:00 AM	2.24	2.24
5 June, 9:00 AM - 12 Noon	2.00	4.24
5 June, 12 Noon - 7:00 PM	2.20	6.44
5 June, 7:00 PM - 6 June, 8:30 AM	2.28	8.72
6 June, 8:30 AM - 7 June, 8:30 AM	1.31	10.03

b. Discharge. The peak discharge at the Wepawaug River gage in June 1982, was estimated by the USGS to have been about 5,000 cfs. The cursory hydraulic analysis made for this study tended to confirm the estimate of the USGS. Using high water elevation data provided by city officials and cross section data from past Flood Insurance Studies, indicated the flow was probably not greater than 5,000 cfs and may have been some less but generally confirmed the estimate of the USGS. The flow of 5,000 cfs was considered applicable from the USGS gage to the mouth at New Haven Avenue. Progressing upstream the peak discharge was less, generally considered proportional to the Milford peak by ratio of respective drainage areas to the 0.7 exponential power.

c. Flood Profile. A June 1982 flood profile through the heavily damaged areas of Milford, as developed from high water data and a flood delineation furnished by the city of Milford, is shown on plates 2 and 3.

5. DISCHARGE FREQUENCIES

Discharge frequency information for the Wepawaug River was developed by statistical analysis of available flow data for the river and by comparison with other longer term streamflow data in the region. Analyses were performed generally in accordance with guidelines set forth in US Water Resources Council Bulletin 17B, "Guidelines for Determining Floodflow Frequency", revised September 1982. Discharge frequencies were developed for the Wepawaug River, at the USGS gage in Milford, both by "Weibull" plotting of historical data and by statistical analysis using a Log Pearson type III distribution. Annual peak discharges for the period of record are listed in table 1. Owing to the relatively short period of record on the Wepawaug River, and the unusually high June 1982 flood event, comparative statistics were developed both with and without the June 1982 event and this data was compared with longer term records in the region. The Eightmile River gage record at North Plain, Connecticut, and the East Branch Eightmile River gage record at Lyme, Connecticut, were used as the long term records for comparative purposes. The USGS gaging stations on the Eightmile and East Branch Eightmile Rivers have continuous records since 1938 with experienced June 1982 floodflows of 5,800 cfs and 5,170 cfs for drainage areas of 20 and 22 square miles, respectively. The discharge frequency analysis of the Eightmile River, with 45 years of record, compared favorably with the statistics developed using the shorter term Wepawaug River record. A summary of comparative and adopted statistics is shown in table 3. The adopted frequency curve and plotted historical data are shown on plate 4. Discharge frequencies at other locations, upstream of the USGS gage, were considered proportional to those at Milford by ratio of respective drainage areas to the 0.7 exponential power, a relationship found generally applicable in past regional streamflow studies.

6. HYDRAULIC REACHES

For purposes of this reconnaissance study, the Wepawaug River was divided into eight hydraulic reaches. Following is a brief description of each reach and pertinent data is listed in table 4.

a. Reach No. 1. From the headwater of New Haven Avenue Dam to the tailwater of City Hall Dam the river flows through the densely commercialized downtown section of Milford. The downstream New Haven Dam is the upstream limit of the Long Island Sound tidal influence and during normal flow acts as the hydraulic control for the subject upstream reach. However, during extremely high flows such as those of June 1982, the hydraulic control is believed to switch from the dam to the restrictive opening of the New Haven Avenue bridge, located just downstream of the dam.

b. Reach No. 2. From the headwater of City Hall Dam to the tailwater of Maple Street Dam the Wepawaug River flows through a predominantly residential area of Milford. River levels in this

TABLE 3

PEAK DISCHARGE FREQUENCIES
COMPARATIVE DATA

River	D.A. (sq.mi.)	Years of Record (years)	Basin Slope (ft/mi)	Mean	Std.	Skew	Mean/Square Mile*	Est. June 1982 Flood
East Branch Eightmile River at Lyme, CT	22.0	45	50.0	2.856	0.2363	1.7	1.916	5170
(Prior to 1982)		(44)		(2.837)	(0.1991	(1.4)	(1.897)	
Eightmile River at North Plain, CT	20.0	45	45.0	2.934	0.2676	0.7	2.023	5800
(Prior to 1982)		(44)		(2.915)	(0.2385)	(0.3)	(2.004)	
Wepawaug River at Milford, CT	18.4	21	40.0	2.823	0.3118	1.0	1.937	5000
(Prior to 1982)		(20)		(2.780)	(0.2445)	(0.3)	(1.894)	
ADOPTED	18.4	21	40.0	2.823	0.3118	0.7	1.937	5000

*Mean/sq. mile = Mean - 0.7 Log D.A.

TABLE 4

HYDRAULIC REACHES
PERTINENT DATA

Reach No.	Location	Length (feet)	Approx. D.A. (sq.mi.)	Est. June 1982 Flood (cfs)
1	New Haven Ave. Dam to City Hall Dam	1400	19.8	5000
2	City Hall Dam to Maple Street Dam	1300	19.8	5000
3	Maple Street Dam to US Route 1	1300	19.0	5000
4	US Route 1 Wells Drive	4000	18.4	5000
5	Wells Drive to Milford/Orange town line	9100	16.6	4600
6	Orange/Milford town line to Lake Wepawaug	7600	15.0	4300
7	Lake Wepawaug to Race Brook	5500	12.4	3700
8	Race Brook to Wepawaug Reservoir	4200	8.0	2700

reach are controlled by City Hall Dam during normal flows plus channel and bridge losses at West Main and Maple Streets during high flows.

c. Reach No. 3. From the headwater of Maple Street Dam to US Route 1, the river flows through a park and residential area of Milford. River levels in this reach are generally governed by the hydraulics of the extremely flat gradient stream with some hydraulic losses at Bridge Street and backwater effect from Maple Street during extremely high flows.

d. Reach No. 4. This reach is a continuation of the very flat gradient stream from US Route 1 upstream to Wells Drive. Levels are generally stream channel controlled with added losses during high flows at Walnut Street and the Interstate 95 bridges. There is also appreciable left overbank flow in Reaches 3 and 4 during floods such as the June 1982 event.

e. Reach No. 5. Between Wells Drive and the upstream Milford/Orange town line the river flows through a park area known as Eisenhower Park, a flat gradient natural storage reach, which governs river levels throughout this reach with some hydraulic losses at Flax Mill Road bridge during high flows.

f. Reach No. 6. Between the Orange/Milford town line and Lake Wepawaug the river flows through a relatively flat residential area with an average slope of about 4 feet per mile. A small dam located above Derby Milford Road has little effect on flood levels. Levels are more highly regulated by the natural conveyance of the flat gradient stream with some hydraulic losses at Derby Milford Road and Prudden Lane bridges during extremely high flows.

g. Reach No. 7. Between Lake Wepawaug and the confluence of Race Brook the river flows through a predominantly residential area of Orange. Lake Wepawaug Dam governs water levels for a distance of about 2,500 feet upstream. The remaining 2,600 feet experiences a relatively steep uniform river slope of about 20 feet per mile resulting in increased natural hydraulic conveyance with some hydraulic losses at Grassy Hill Road and old Grassy Hill Road bridges during extremely high flows.

h. Reach No. 8. This furthest upstream reach is a continuation of the relatively steep gradient stream from the Race Brook confluence upstream to Wepawaug Reservoir. Levels are controlled within this 4,200 foot reach by the natural conveyance of the steep gradient stream.

7. STAGE DISCHARGE RELATIONS

For purposes of this reconnaissance level study, natural stage-discharge relationships for the Wepawaug River were obtained from Flood Insurance Study reports for the town of Milford and Orange, Connecticut. These rating curves were compared, and adjusted in some instances, with the observed stages and discharges experienced in June 1982. Discharge rating curves at selected index stations along the Wepawaug River are shown on plates 5 and 6.

8. STAGE FREQUENCIES

Stage frequency curves were developed using the adopted discharge frequency curves and the developed stage discharge curves. The resulting natural, unmodified stage frequency curves at selected index stations along the Wepawaug River are shown on plates 7 and 8.

9. FLOOD CONTROL MEASURES

a. General. The various structural flood control measures hydrologically considered for the Wepawaug River included (a) upstream flood control reservoirs, (b) bypass tunnels to divert floodflows past damage areas and discharge into Long Island Sound, and (c) flood protection - floodwalls, dikes, and stream channel improvements.

b. Upstream Storage Reservoirs. A cursory hydrologic analysis indicated not more than two flood control reservoir sites within the Wepawaug River basin. Site 1 was located on the main stem

Wepawaug River in Woodbridge, Connecticut, about 500 feet above the Orange-Woodbridge town line. Site 2 was located on Race Brook (a tributary to the Wepawaug River) in Orange, Connecticut, about 2,000 feet below the Orange-Woodbridge town line. The corresponding drainage areas of the sites are 7.0 and 3.0 square miles, respectively. Storage capacity at the sites was determined from USGS topographic maps, and, for initial screening studies, the dams were sized to provide storage capacity equivalent to about 4.0 inches of runoff from their respective drainage areas. The outlet works at each dam were assumed to be fixed gate and sized to discharge about 30 cfs/square mile from their controlled drainage areas. Probable maximum floods were not developed for the two sites but were estimated based on past studies in the general region. Spillways were sized for the estimated probable maximum flood plus five feet of freeboard. Pertinent data on the two sites are listed in table 5. Area-capacity curves for sites 1 and 2 are shown on plates 9 and 10, respectively. Stage-frequency curves, as modified by the upstream storage reservoirs, are shown on plates 7 and 8. Modified curves were developed by reducing flood discharge frequencies by a factor equal to the ratio of remaining uncontrolled drainage area to total drainage area to the 0.7 exponential power and then adding the regulated reservoir release. It is noted that the stage frequency curves reflect the combined effect of both reservoirs except for index station 8 which is affected only by reservoir 1.

d. Bypass Tunnels. Three different tunnel plans were considered as part of the Wepawaug River Expanded Reconnaissance study. With plan 1, a tunnel would extend from the mouth of the Wepawaug River (Long Island Sound) to just above the New Haven Avenue Dam. With plan 2 the tunnel would extend from Long Island Sound to just above City Hall Dam. Tunnel lengths for plans 1 and 2 would be about 200

TABLE 5

WEPAWAUG RIVER
FLOOD STORAGE RESERVOIR SITES
PERTINENT DATA

	Item	Storage Site No. 1	Storage Site No. 2
1.	Location	Wepawaug River, Woodbridge, Connecticut 500 feet above town line	Race Brook, Orange, Connecticut 2000 feet below Woodbridge-Orange town line
2.	Drainage Area	7.0 sq. mi.	3.0 sq. mi.
3.	Storage Capacity	1500 ac-ft (4.0 in. R.O.)	600 ac-ft (4.0 in. R.O.)
4.	Invert Elevation	190.0 ft. NGVD	150.0 ft. NGVD
5.	Spillway Crest Elev.	209.0 ft. NGVD	182.0 ft. NGVD
6.	Design Surcharge	9 feet	8 feet
7.	Freeboard	5 feet	5 feet
8.	Top of Dam	223.0 ft. NGVD	195.0 ft. NGVD
9.	Landtaking Elev. (no. acres)	214.0 ft. NGVD 160	187.0 ft. NGVD 60
10.	Spillway Length	100 feet	70 feet
11.	Outlet Conduit	4.0 ft. Diam.	4.0 ft. Diam.

and 1500 feet, respectively. Tunnel plan 3 however, would divert flows from upstream of Wells Drive in Milford to Long Island Sound, a distance of about 7,000 feet. Each tunnel was sized for an estimated Standard Project Flood (10,000 cfs) less an approximate 1,500 cfs channel capacity, for a net design flow of about 8,500 cfs. A Standard Project Flood was not developed for the basin but was estimated based on past standard project flood determinations in the region. An SPF runoff rate of 500 to 600 cfs/square mile was considered applicable for an 18.4 square mile coastal stream like the Wepawaug River. While this estimation is considered adequate for a reconnaissance level of study, a more definitive hydrologic analysis would be a part of any more detailed design studies.

Tunnel head differentials were based on a tailwater elevation of +9.0 feet NGVD (10-year frequency tide) in Long Island Sound and a headwater elevation corresponding to a channel flow of 1,500 cfs at the inlet location for each tunnel plan. Discharge capacities were computed using the Manning's equation with a Manning's coefficient "n" of 0.015 for a smooth tunnel, and entrance and exit loss coefficients of 0.5 and 1.0, respectively. Benefits associated with each tunnel plan would occur primarily downstream of the tunnel inlet with the exception of tunnel 1 where channelization upstream to City Hall Dam would also be required. Such channelization would be necessary to convey the SPF through Reach No. 1 to the tunnel inlet. The channel would consist of a normally submerged concrete rectangular channel 13 feet deep by 33 feet wide, or the hydraulic equivalent. Pertinent data on the bypass tunnel plans are listed in table 6. Also included in table 6 for comparison purposes, are tunnel sizes required to convey the estimated 100-year frequency discharge of 5,000 cfs less an approximate 1,500 cfs channel capacity.

d. Local Protection. For purposes of initial screening, all local improvements including floodwall construction were sized for

TABLE 6

BYPASS TUNNELS PERTINENT DATA

Tunnel Plan	Location	Length (feet)	Head Differential (feet)	SPF Diameter (feet)	SPF Capacity (cfs)	100-year Diameter (feet)	100-year Capacity (cfs)
1	Long Island Sound to New Haven Avenue Dam	200	10.0	23.0	8500*	16.0	3500**
2	Long Island Sound to City Hall Dam	1500	20.5	22.0	8500*	15.0	3500**
3	Long Island Sound to 1600± feet above I-95	7000	31.0	24.0	8500*	17.0	3500**

*Discharge capacity is equal to the estimated SPF less 1500 cfs channel capacity

**Discharge capacity is equal to 100-year frequency discharge less 1500 cfs channel capacity.

the experienced June 1982 flood discharge (100-year frequency). Modified flood levels, as a result of the improvements were determined by approximate calculations considered adequate for preliminary costing purposes. Local improvement plans were considered only for the heavily damaged areas of Milford in reaches 1 through 4, and for one localized area within reach 6 in Orange, which experienced heavy residential damage during the June 1982 flood. A brief description of the plans of improvement by reach number follows:

(1) Reach No. 1. Between New Haven Avenue Dam and City Hall Dam three alternative plans were considered:

(a) Alternative 1 considered the construction of a concrete floodwall along the right bank of the Wepawaug River from New Haven Avenue approximately 1,400 feet upstream to City Hall Dam. The wall was sized for 1 foot of freeboard above the 1982 flood level resulting in a top elevation of 26.0 feet NGVD at New Haven Avenue and rising at a uniform slope to a top elevation of 28.0 feet NGVD at the downstream side of City Hall Dam. An interior drainage interceptor system was sized for the interior drainage area located behind the floodwall. Using 100-year frequency storm rainfall over the interior area of about 160 acres resulted in an estimated peak flow of about 340 cfs. A 6-foot diameter storm drain located in River Street extending from near City Hall to Long Island Sound, for a total distance of about 1200 feet, was suggested for costing purposes. It was assumed, for purposes of this study, that the storm drain could be constructed deep enough to intercept all existing lateral drains presently discharging to the river through the proposed line of protection.

(b) Alternative 2 improvements within reach 1 would consist of a lower floodwall in combination with an enlarged channel from City Hall Dam to New Haven Avenue and a pressure conduit from New Haven Avenue to Long Island Sound. The top of the floodwall along the right side of the river would be 23.0 feet NGVD at New Haven Avenue and rising at a uniform slope to a top elevation at the downstream side of City Hall Dam of 25.0 feet NGVD, providing one foot of freeboard throughout its length. The same interior drainage interceptor system, as described before, would also be applicable for this alternative. The channel improvement would consist of a normally submerged rectangular channel approximately 8 feet deep by 25 feet wide (or its hydraulic equivalent) extending from City Hall Dam to the pressure conduit entrance. The pressure conduit would be 10 feet high by 12 feet wide or, the equivalent, with a 15 foot x 15 foot tainter gage at its entrance, extending from above New Haven Avenue to Milford Harbor (approximately 1,000 feet). The pressure conduit was designed for a tailwater elevation of +9.0 feet NGVD in Long Island Sound and a headwater elevation of 22.0 feet NGVD at its entrance resulting in a net head differential of 13 feet. Entrance and exit loss coefficients of 0.5 and 1.0, respectively, were used and resulted in a velocity of about 16 feet per second under design flow conditions.

(c) The final alternative for reach 1 would consist of no floodwalls but rather the construction of a larger twin 10'H x 15'W pressure conduit, with a 12'H x 25'W tainter gate entrance, extending from above New Haven Avenue Dam to the harbor, and the construction of a larger improved channel upstream to City Hall Dam. The required channel would be a normally submerged rectangular channel approximately 9 feet deep by 40 feet wide or the equivalent. The pressure conduit system was designed for a tailwater of +9.0 feet NGVD and a headwater (above New Haven Avenue Dam) of +18.0 feet NGVD. A headwater elevation of +18.0 feet NGVD at New Haven Avenue Dam corresponds to a flow of about 600 cfs which would be passed downstream, resulting in a pressure conduit design flow of 4,400 cfs. Using the same entrance and exit loss coefficients as described in alternative 2, a velocity of about 14 feet per second in the twin conduits would result.

(2) Reach No. 2. The plan consisted of raising the elevation of a presently existing floodwall along the right bank of the river from City Hall Dam upstream approximately 350 feet to West Main Street bridge. The top of the wall at City Hall Dam would be elevation 32.0 feet NGVD and rising at a uniform slope to elevation 32.5 feet NGVD at West Main Street, thus providing 1 foot of freeboard. West Main Street bridge would be replaced and Maple Street bridge modified for improved hydraulics. For preliminary costing purposes, a triple box opening, each box being 47 feet wide and about 6 feet high was suggested for West Main Street and an increase of about 100 square feet on both sides of the Maple Street bridge (15 feet wide by 9 feet high arch opening on each side) was recommended for Maple Street.

(3) Reach No. 3. Between Maple Street Dam and US Route 1, the plan of improvement consisted of removing the Maple Street Dam down to elevation 26.0 feet NGVD and dredging an 80-foot wide trapezoidal channel upstream approximately 100 feet upstream to invert elevation 27.0 feet NGVD. In order to maintain the presently existing normal aesthetic pool above Maple Street Dam through the park area, it was assumed for purposes of this study that a bascule type gate would replace the Maple Street Dam. Such a gate would be about 3.5 feet high and 80 feet long with a top elevation at about 29.4 feet NGVD.

(4) Reach No. 4. Between US Route 1 and Wells Drive, the plans of improvement consisted of replacing the US Route 1 bridge with a hydraulically nonrestricting structure as well as the construction of a new channel for increased hydraulic conveyance from US Route 1 upstream approximately 1,300 feet to Walnut Street. For preliminary costing purposes, a triple box opening 30 feet wide by 8 feet high

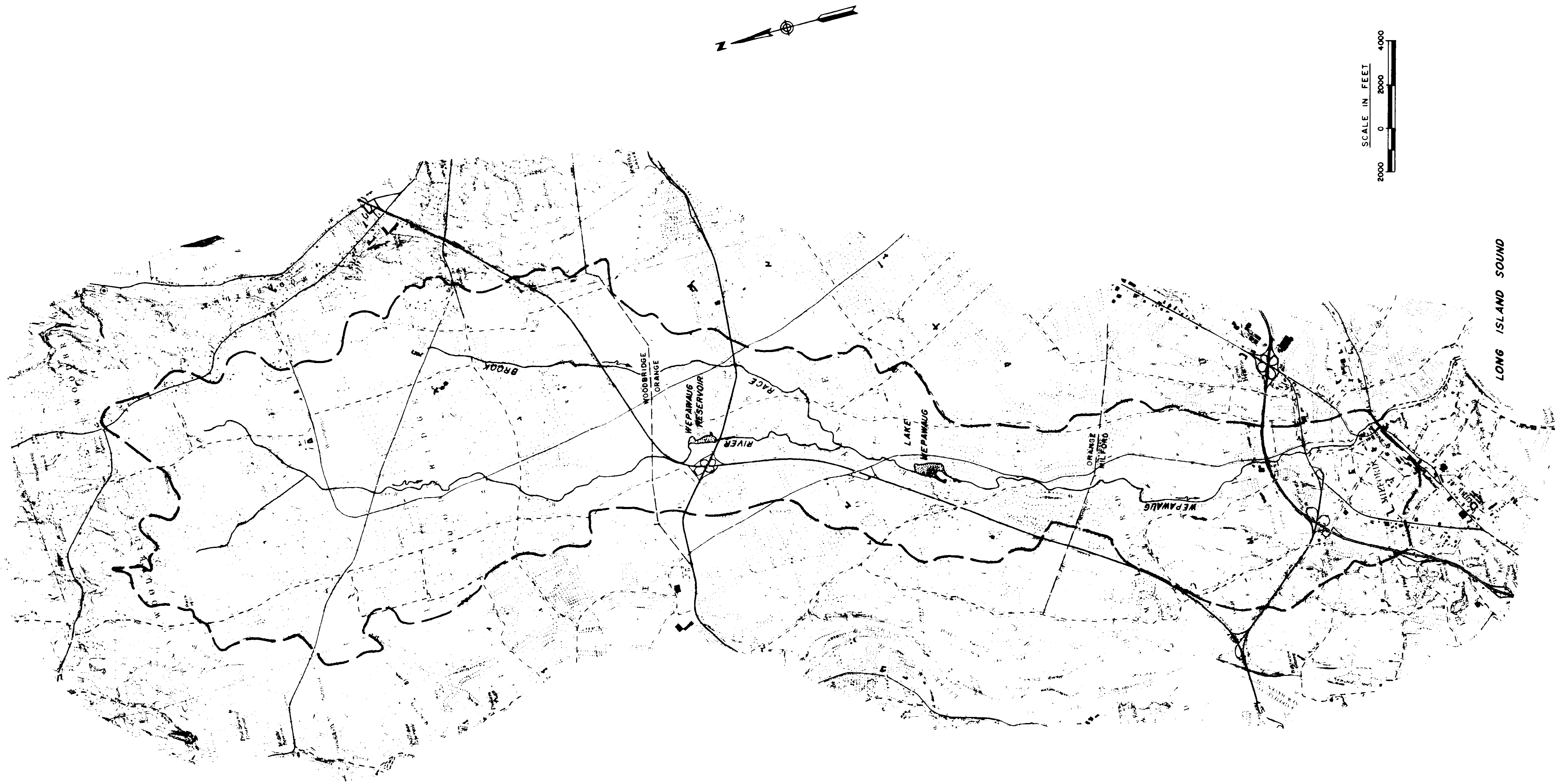
was recommended for the US Route 1 bridge and an improved trapezoidal channel with an 80 foot bottom width and 1V:2H side slopes would be constructed extending from Route 1 to Walnut Street bridge. The channel would have an invert elevation of 30 feet NGVD at Walnut Street and slope to elevation 28.0 feet at Route 1.

No channel improvements would be made between Walnut Street and Wells Drive. Flood protection at a large industrial building on the right bank between the Connecticut Turnpike and Wells Drive would be accomplished by flood-proofing with a system of low walls surrounding the building. Similarly, flood-proofing would be recommended at residential structures upstream of Wells Drive, if found economically feasible.

Plates 2 and 3 show the profile of the June 1982 flood as modified by the proposed channel improvements within reach numbers 1 through 4. Modified discharge rating curves as well as stage-frequency curves representing these channel improvements are shown on plates 5 and 7, respectively.

(5) Reach No. 6. Within reach number 6 from Derby Milford Road to Prudden Lane, the plans of improvement consisted of: (a) the removal of a small dam, located about 100 feet above Derby Milford Road, and (b) the construction of a new channel for increased hydraulic conveyance. A trapezoidal channel with an 80-foot bottom width and 1V:4H side slopes extending from the location of the small dam (to be removed) to Prudden Lane, a distance of about 4,000 feet was recommended for costing purposes. The improved channel invert would extend from elevation 66.0 feet NGVD at the former dam location to elevation 68.0 feet NGVD at Prudden Lane. The modified discharge rating curve as well as the modified stage frequency curve for index station 6B, representing the channel improvements within reach 6, are shown on plates 6 and 8, respectively.

CORPS OF ENGINEERS | A | B | C | D | E | F | G | H | U. S. ARMY



SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DES BY | DR BY | CK BY

SUBMITTED

CHIEF, CIVIL ENGR SECTION

APPROVAL RECOMMENDED

CHIEF, DESIGN BRANCH

REVIEWED

PROJECT MANAGER

APPROVAL RECOMMENDED

WEPAWAUG RIVER BASIN

WEPAWAUG RIVER, CT.

WATERSHED MAP

HYDRO. ENG. SECT.

APPROVED | DATE

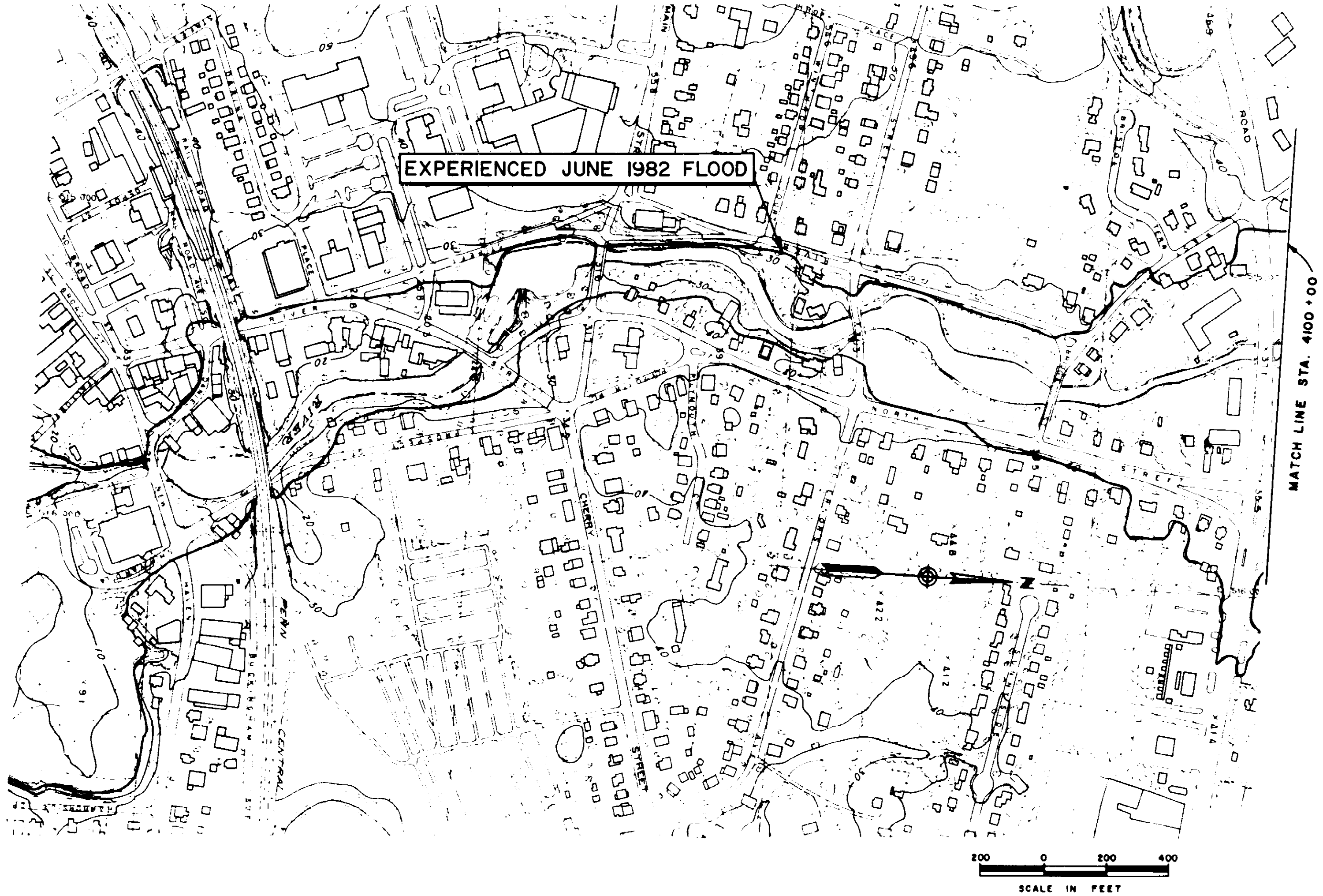
CHIEF, ENGINEERING DIVISION

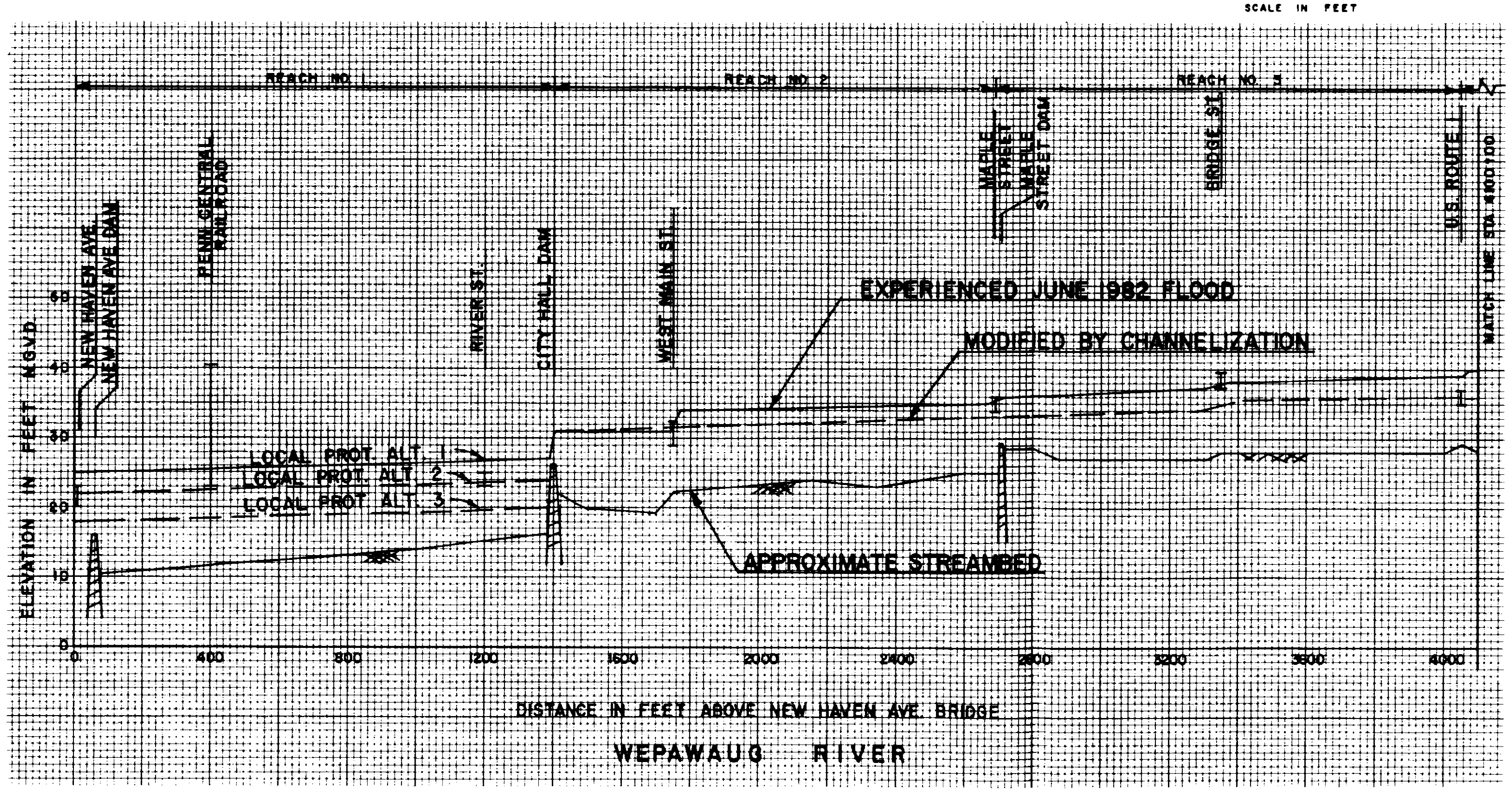
SCALE | SPEC. NO.

DRAWING NUMBER

SHEET

PLATE 1





NOTES:
SEE TEXT FOR DESCRIPTION OF CHANNEL MODIFICATION PLANS.

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WEPAWAUG RIVER BASIN
WEPAWAUG RIVER, CT.

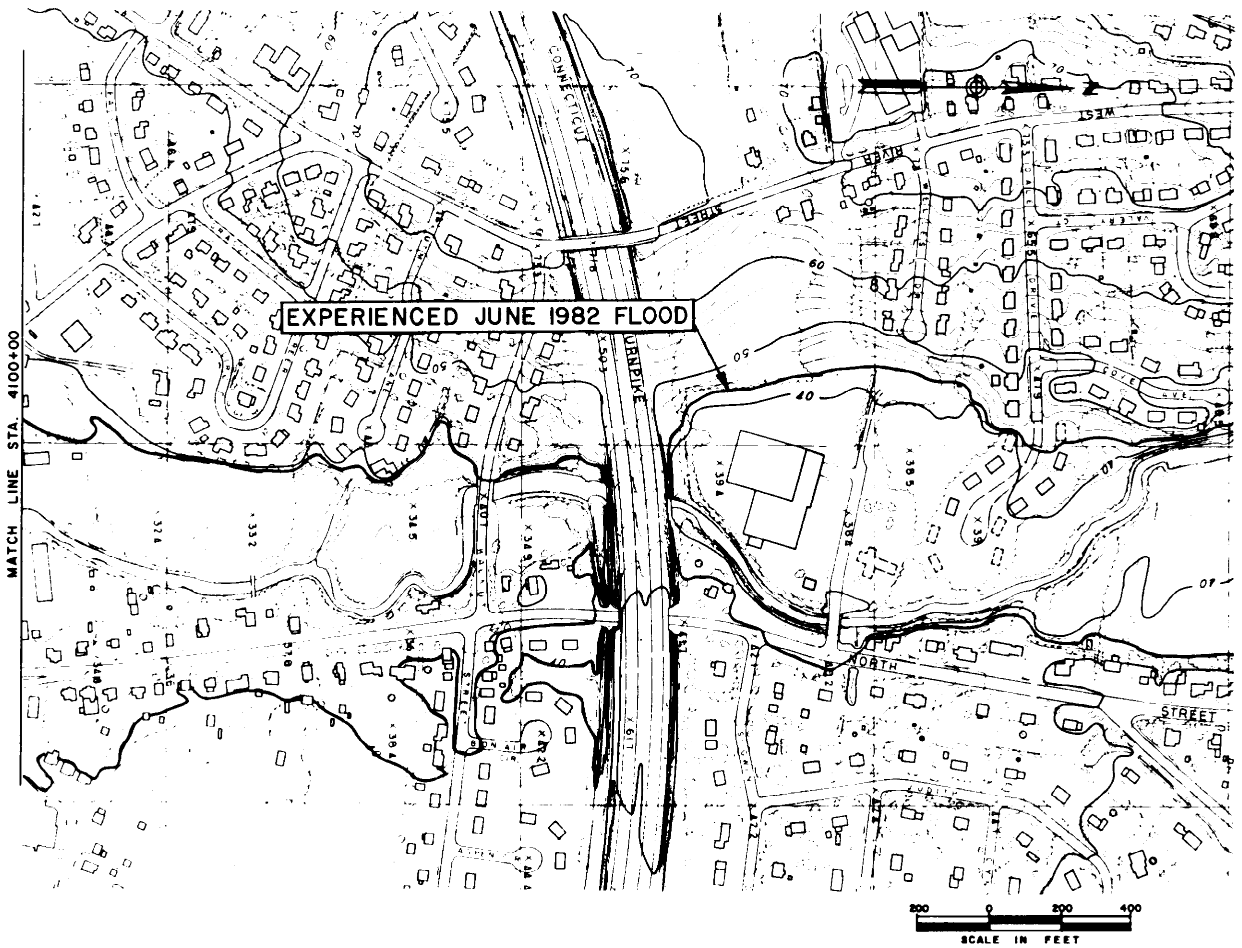
PLAN AND PROFILE # 1
MILFORD, CT.

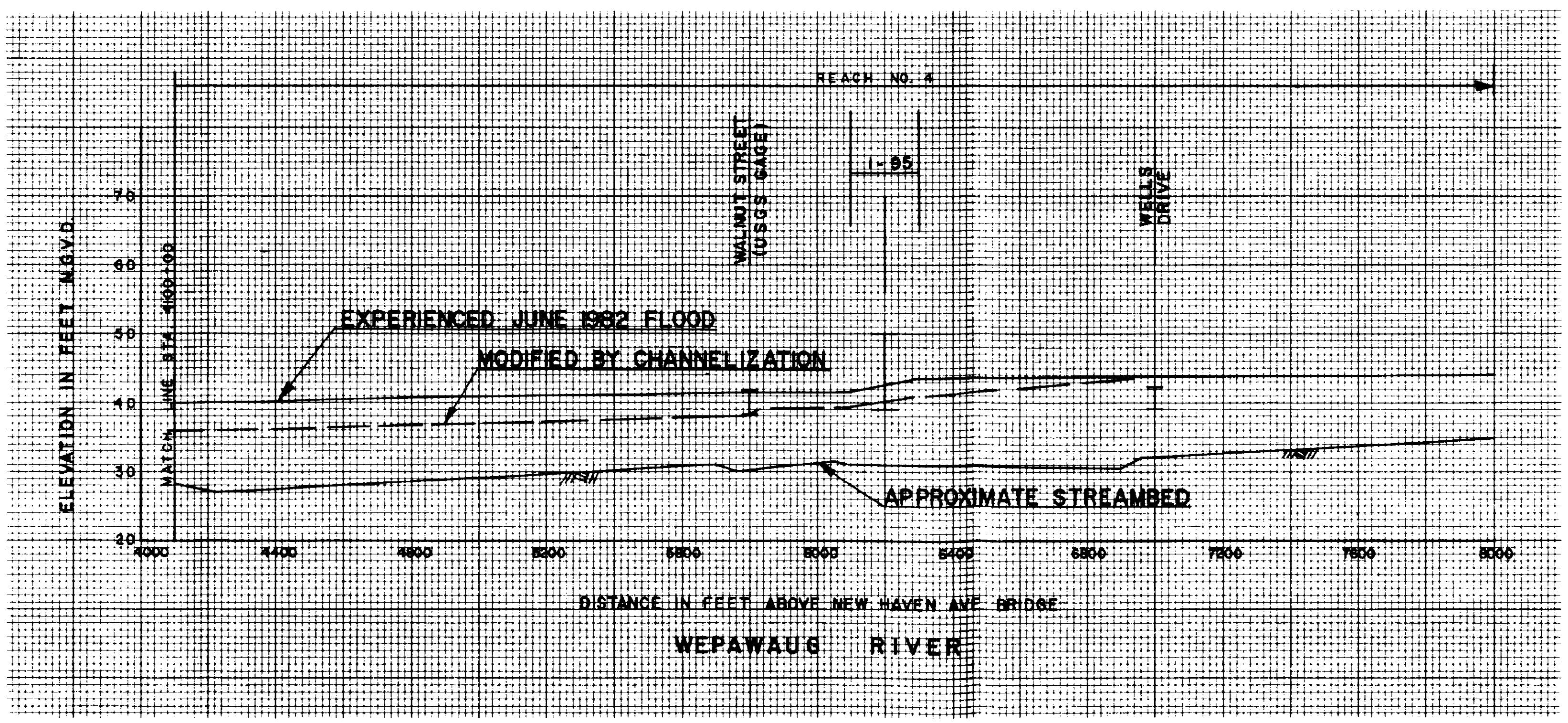
DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, CIVIL ENGR. SECTION
APPROVAL RECOMMENDED:
CHIEF, DESIGN BRANCH
REVIEWED:
PROJECT MANAGER
HYDRO. ENG. SECT.
APPROVAL RECOMMENDED:
APPROVED
DATE
CHIEF, BRANCH
CHIEF, ENGINEERING DIVISION
SCALE
SPEC. NO.
DRAWING NUMBER
SHEET

U. S. ARMY

PLATE 2

CORPS OF ENGINEERS | A | B | C | D | E | F | G | H | U. S. ARMY





NOTES:
SEE TEXT FOR DESCRIPTION OF CHANNEL MODIFICATION PLANS.

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY

SUBMITTED:

CHIEF, CIVIL ENGR. SECTION

APPROVAL RECOMMENDED:

CHIEF, DESIGN BRANCH

REVIEWED:

PROJECT MANAGER

APPROVAL RECOMMENDED:

CHIEF, PROJECT BRANCH

WEPAWAUG RIVER BASIN
WEPAWAUG RIVER, CT.

PLAN AND PROFILE # 2
MILFORD, CT.

HYDRO. ENG. SECT.

APPROVED | DATE

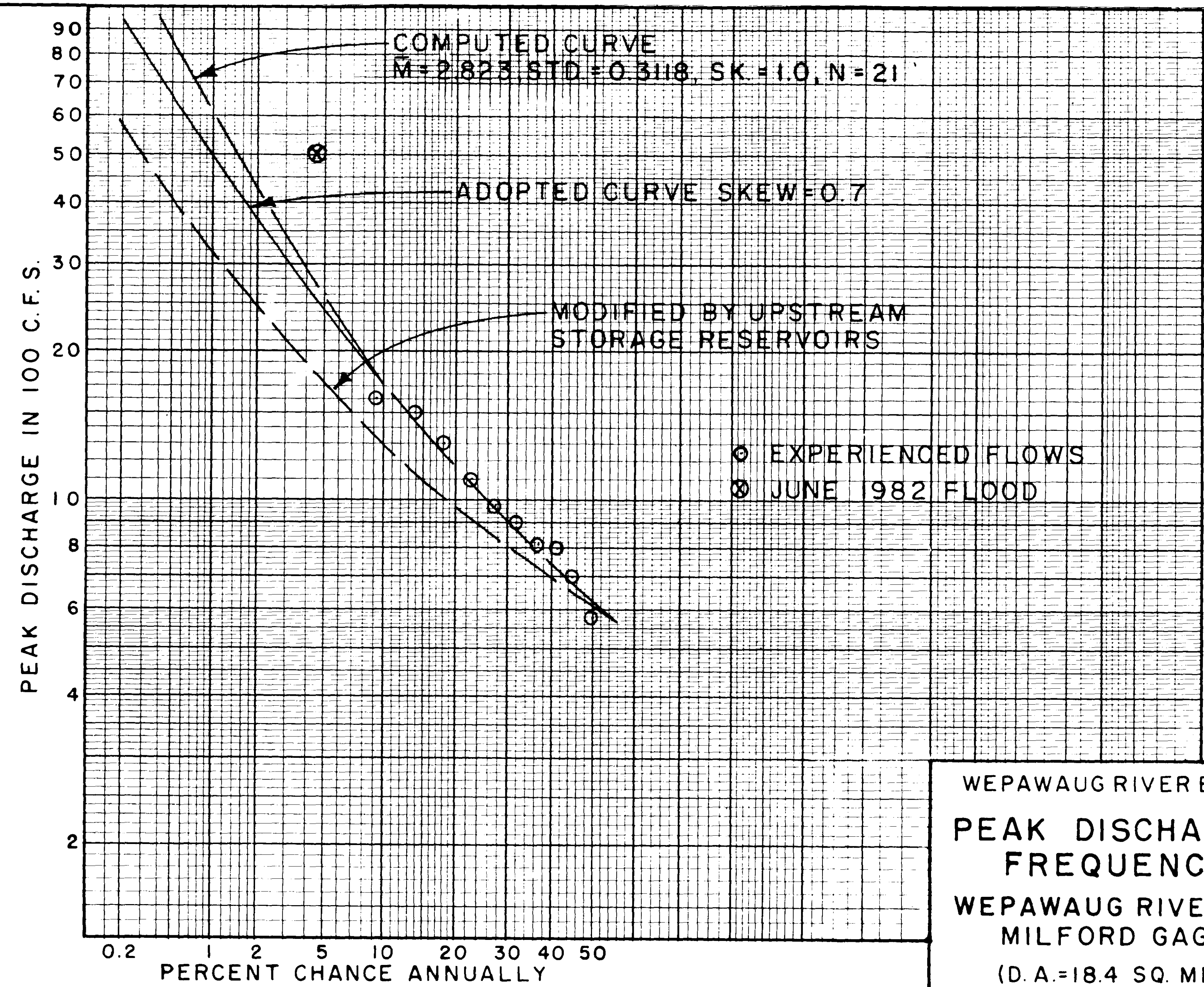
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO.

DRAWING NUMBER

SHEET

PLATE 3



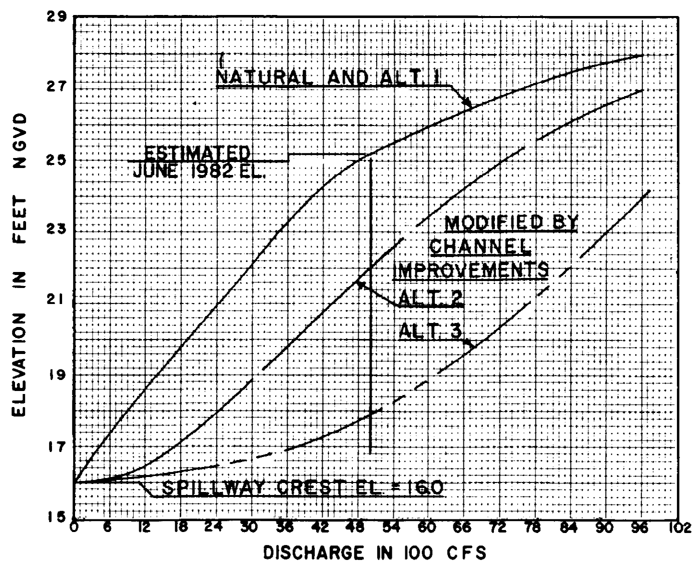
WEPAWAUG RIVER BASIN

PEAK DISCHARGE FREQUENCY

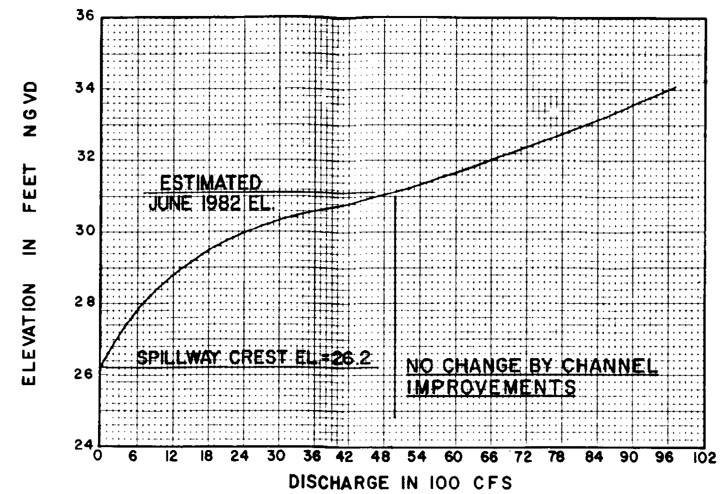
WEPAWAUG RIVER AT MILFORD GAGE

(D. A. = 18.4 SQ. MI.)

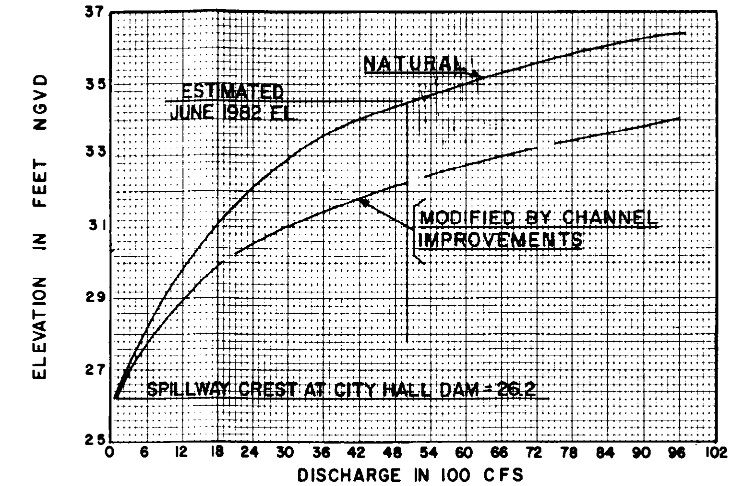
PLATE 4



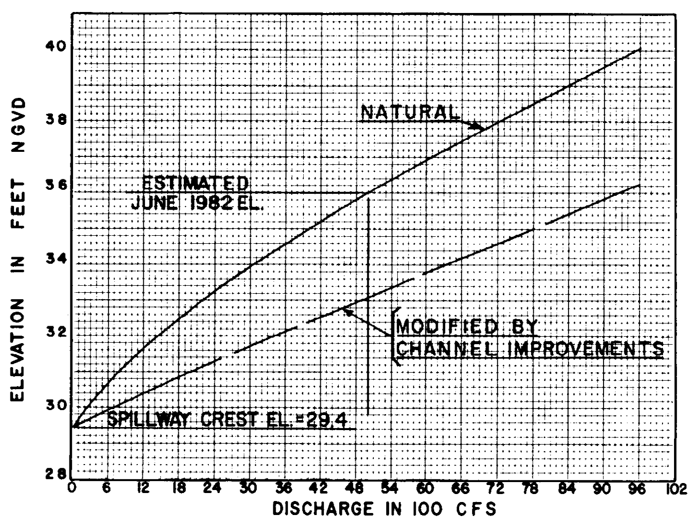
INDEX STATION NO. 1
NEW HAVEN AVE. DAM
(D.A.=19.8 SQ. MI.)



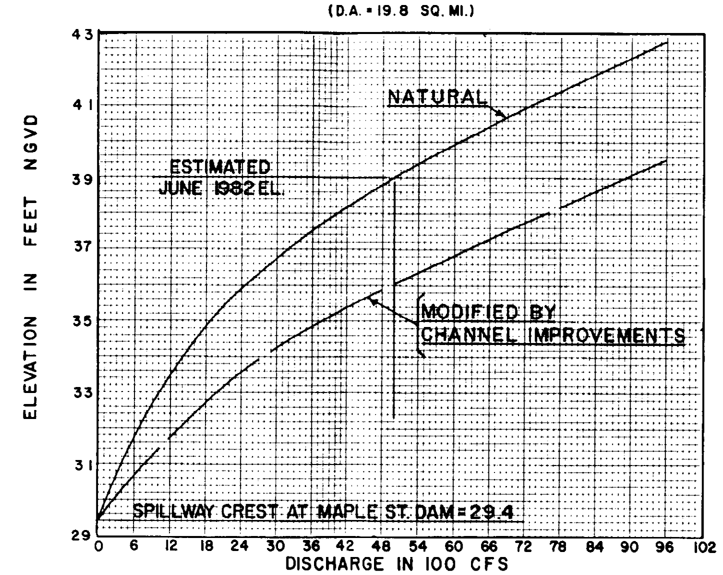
INDEX STATION NO. 2A
CITY HALL DAM
(D.A.=19.8 SQ. MI.)



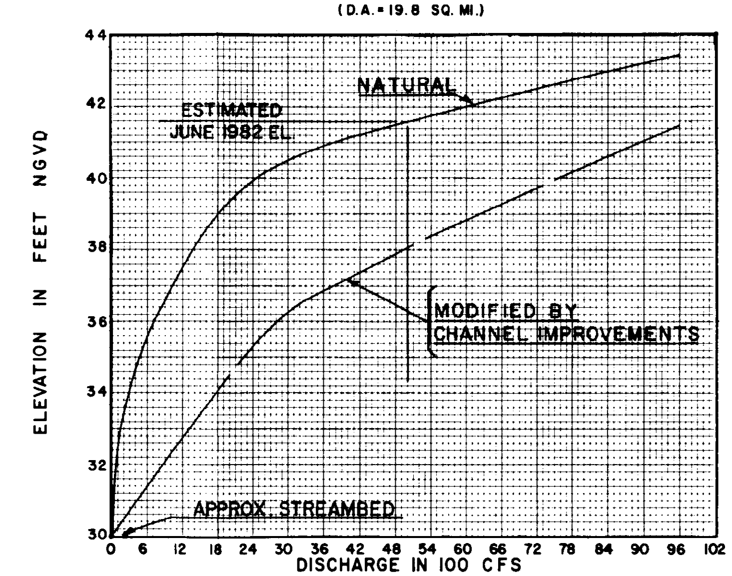
INDEX STATION NO. 2B
400± FT. UPSTREAM W. MAIN ST.
(D.A.=19.8 SQ. MI.)



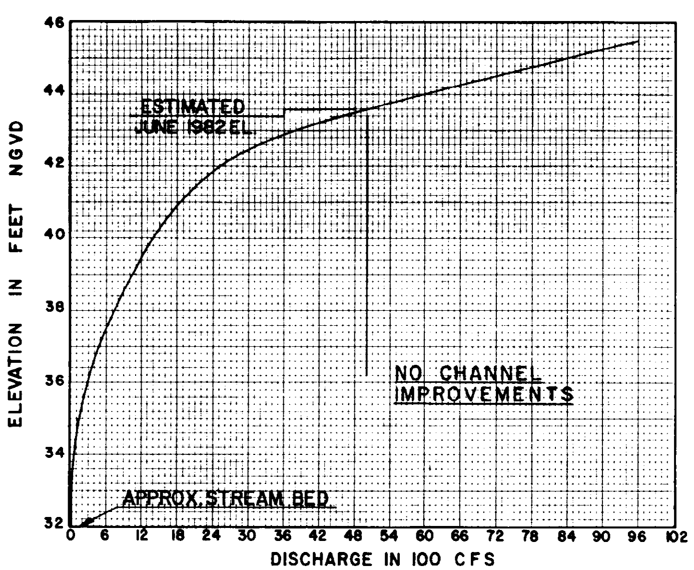
INDEX STATION NO. 3A
MAPLE ST. DAM
(D.A.=19.0 SQ. MI.)



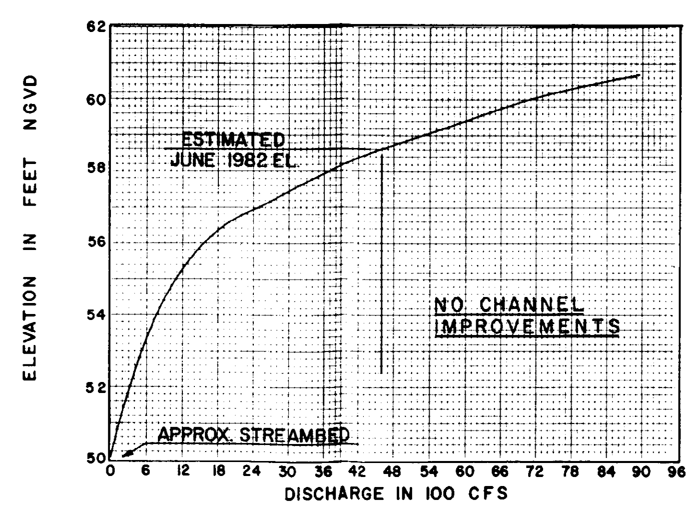
INDEX STATION NO. 3B
ROUTE 1
(D.A.=19.0 SQ. MI.)



INDEX STATION NO. 4A
WALNUT ST. (USGS GAGE)
(D.A.=18.4 SQ. MI.)



INDEX STATION NO. 4B
WELLS DRIVE
(D.A.=18.4 SQ. MI.)



INDEX STATION NO. 5
EISENHOWER PARK (14,500 FT. UPSTREAM MOUTH)
(D.A.=15.0 SQ. MI.)

SAFETY PAYS

GRAPHIC SCALES

REVISION | DATE | DESCRIPTION | BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

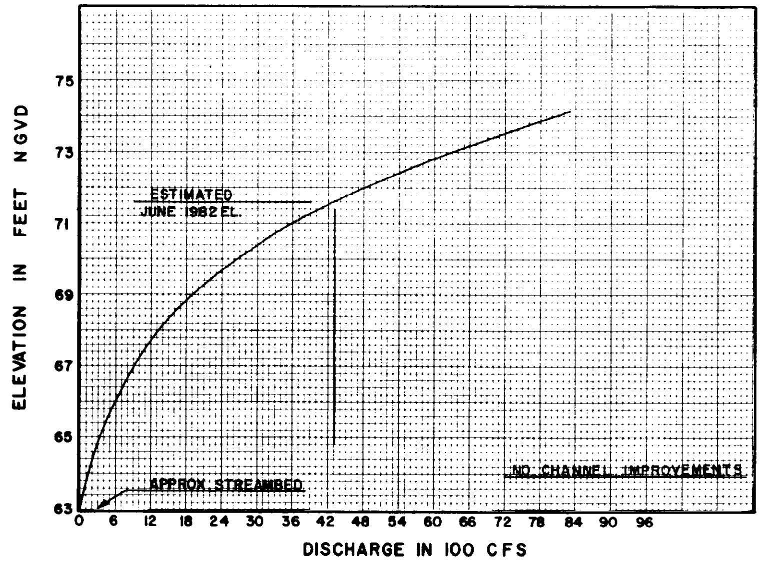
WEPAWAUG RIVER BASIN
WEPAWAUG RIVER, CT.

DISCHARGE RATING CURVES
MILFORD CT.

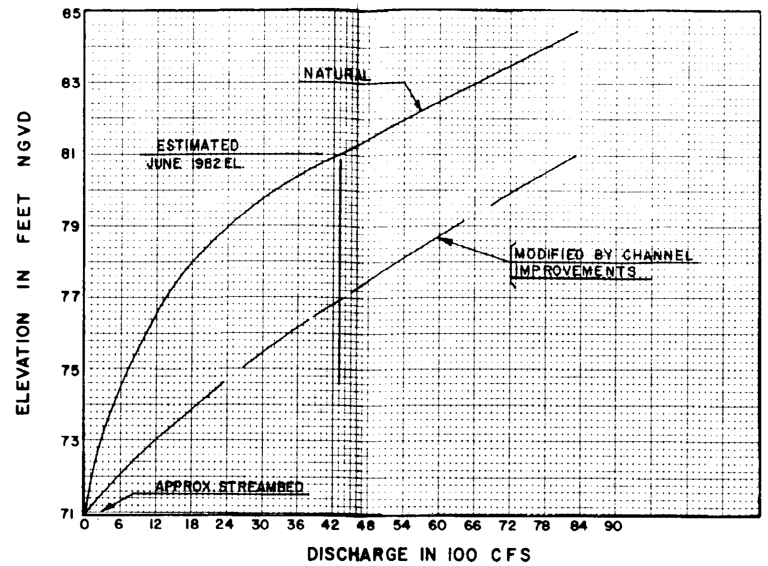
HYDRO. ENG. SECT.

DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, DESIGN BRANCH
REVIEWED:
PROJECT MANAGER
APPROVAL RECOMMENDED:
CHIEF, PROJECT MNGT. BRANCH
APPROVED | DATE
CHIEF, ENGINEERING DIVISION
SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

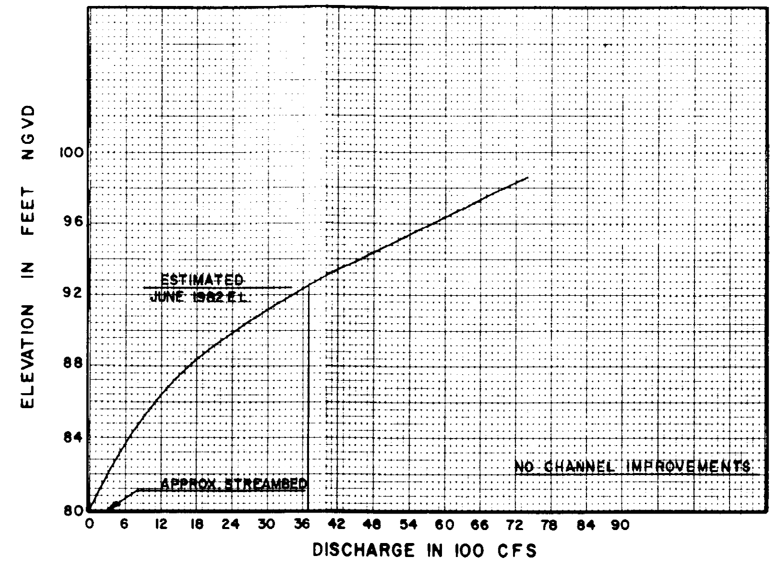
CORPS OF ENGINEERS | U. S. ARMY



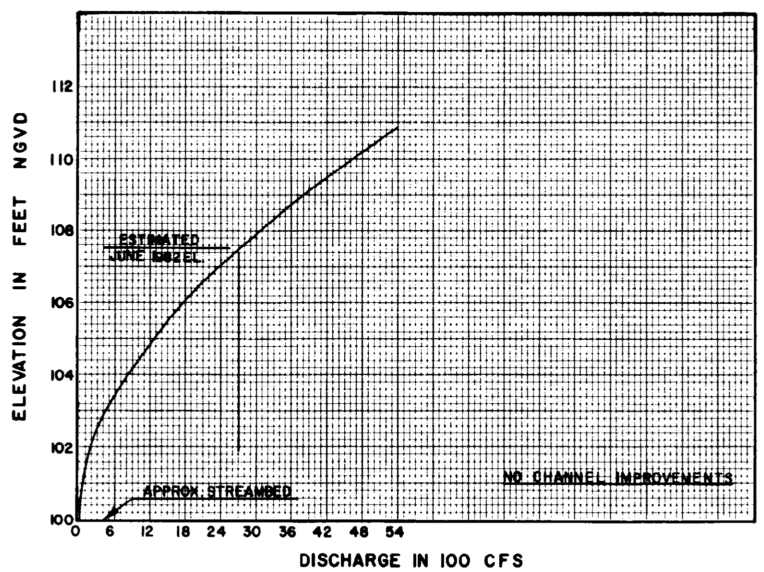
INDEX STATION NO. 6A
1500± FT. UPSTREAM ORANGE / MILFORD TOWNLINE
(D.A. = 15.0 SQ. MI.)



INDEX STATION NO. 6B
PRUDDEN LANE
(D.A. = 15.0 SQ. MI.)



INDEX STATION NO. 7
100± FT. UPSTREAM OLD GRASSY HILL ROAD
(D.A. = 12.4 SQ. MI.)



INDEX STATION NO. 8
16,000± FT. UPSTREAM ORANGE/MILFORD TOWNLINE
(D.A. = 8.0 SQ. MI.)

SAFETY PAYS

GRAPHIC SCALES

REVISION	DATE	DESCRIPTION	BY

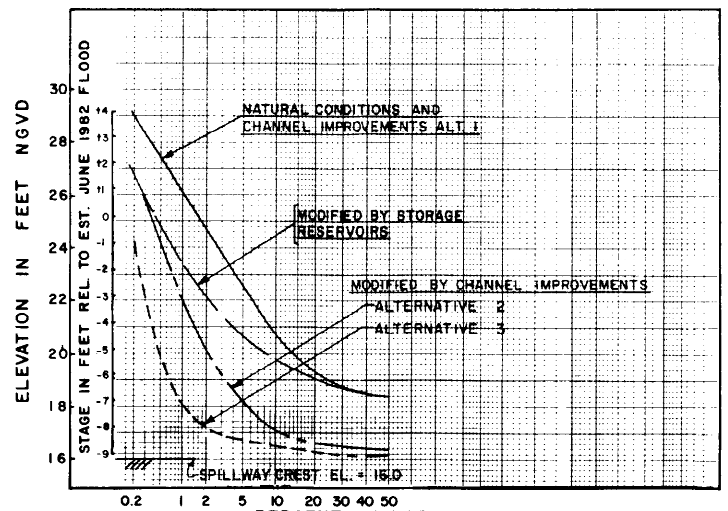
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, DESIGN BRANCH
REVIEWED:
PROJECT MANAGER
APPROVAL RECOMMENDED:
CHIEF, PROJECT MNGT. BRANCH

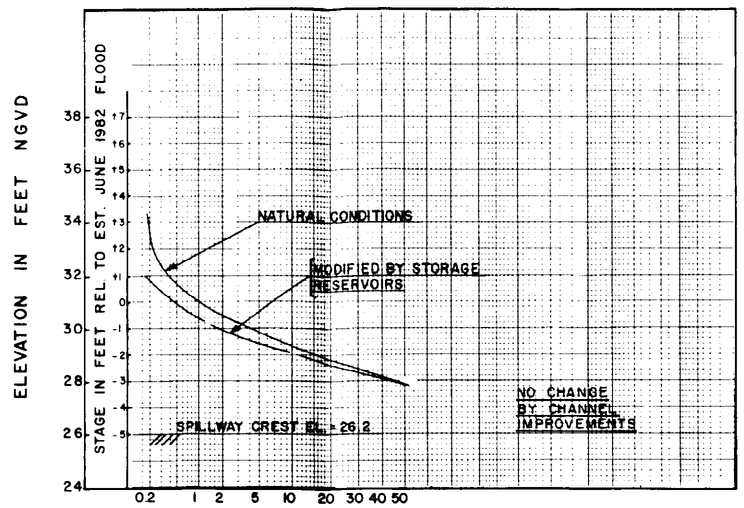
WEPAWAUG RIVER BASIN
WEPAWAUG RIVER, CT.

DISCHARGE RATING CURVES
TOWN OF ORANGE, CT.

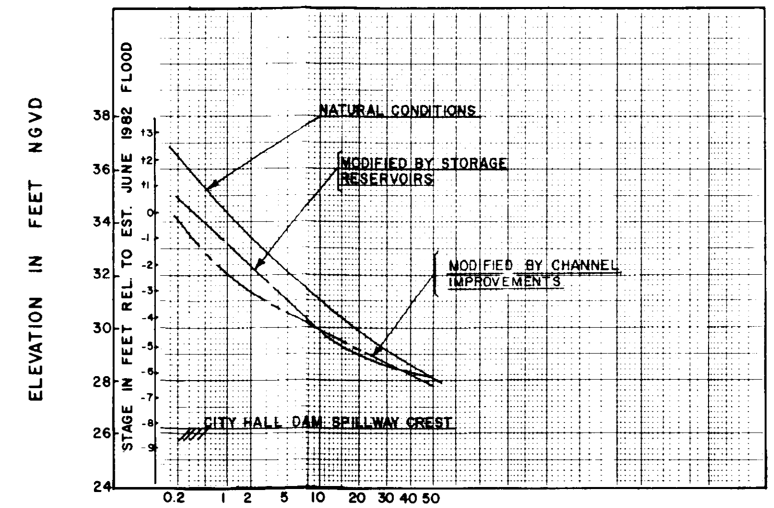
HYDRO. ENG. SECT.
APPROVED | DATE
CHIEF, ENGINEERING DIVISION
SCALE | SPEC. NO.
DRAWING NUMBER
SHEET



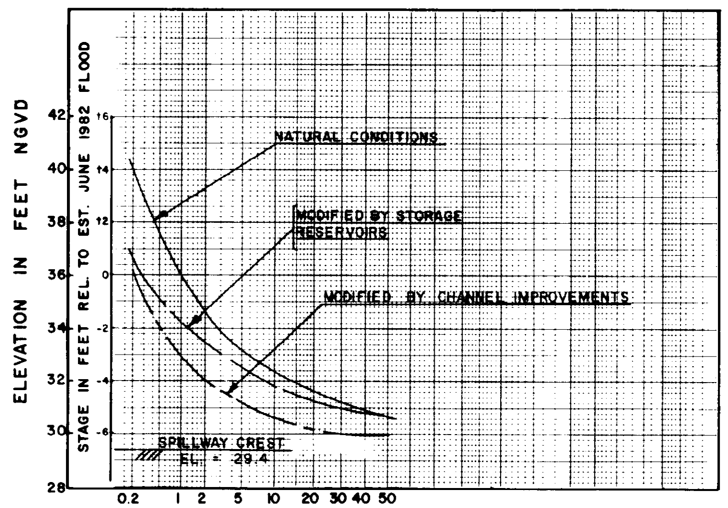
INDEX STATION NO. 1
NEW HAVEN AVE. DAM
(D.A. = 19.8 SQ. MI.)



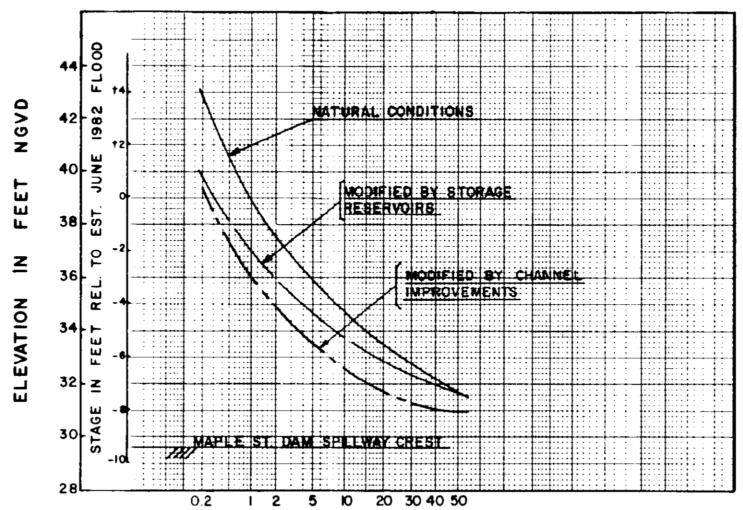
INDEX STATION NO. 2A
CITY HALL DAM
(D.A. = 19.8 SQ. MI.)



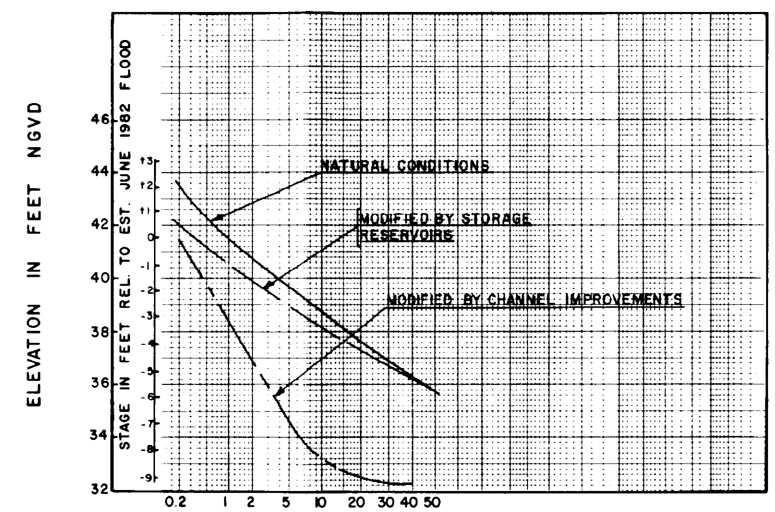
INDEX STATION NO. 2B
400± FT. UPSTREAM W. MAIN ST.
(D.A. = 19.8 SQ. MI.)



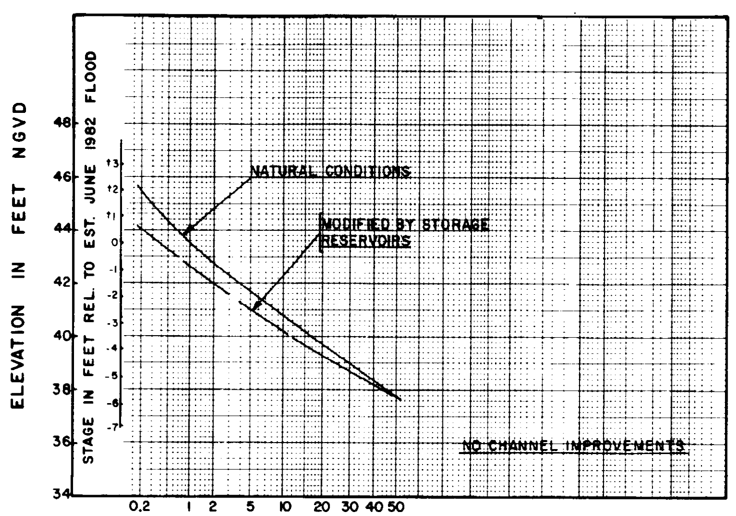
INDEX STATION NO. 3A
MAPLE ST. DAM
(D.A. = 19.0 SQ. MI.)



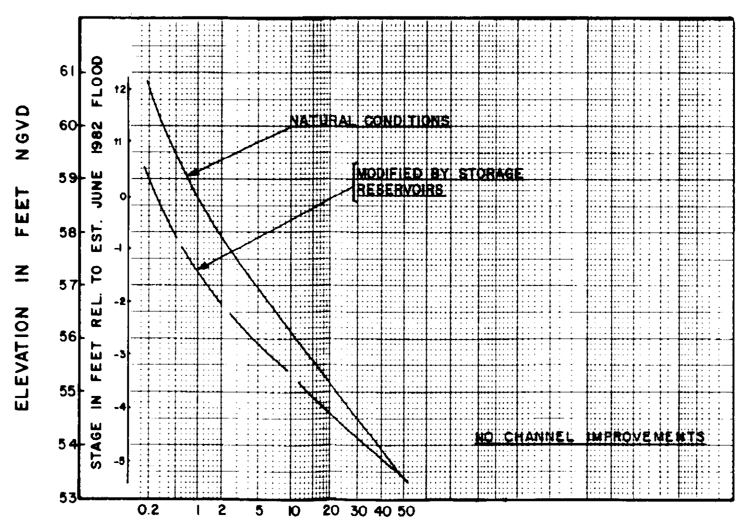
INDEX STATION NO. 3B
ROUTE 1
(D.A. = 19.0 SQ. MI.)



INDEX STATION NO. 4A
WALNUT ST. (USGS GAGE)
(D.A. = 18.4 SQ. MI.)



INDEX STATION NO. 4B
WELLS DRIVE
(D.A. = 18.4 SQ. MI.)



INDEX STATION NO. 5
EISENHOWER PARK (14,500 FT. UPSTREAM MOUTH)
(D.A. = 15.0 SQ. MI.)

SAFETY PAYS

GRAPHIC SCALES

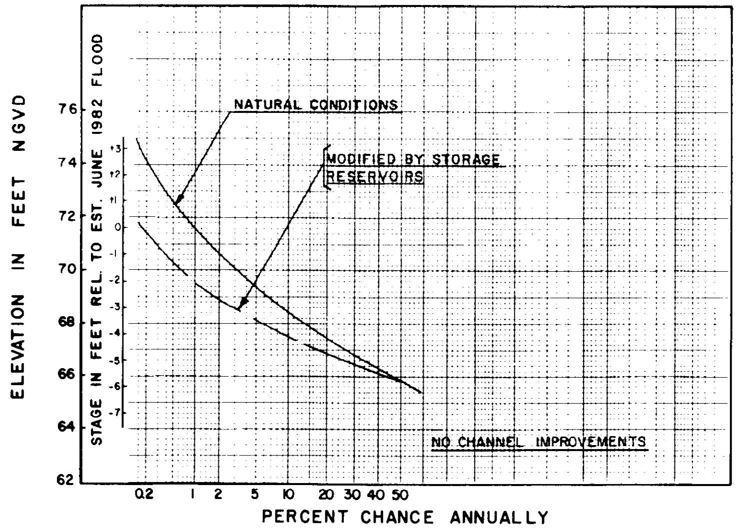
REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

WEPAWAUG RIVER BASIN
WEPAWAUG RIVER, CT.

STAGE FREQUENCY CURVES
MILFORD CT.

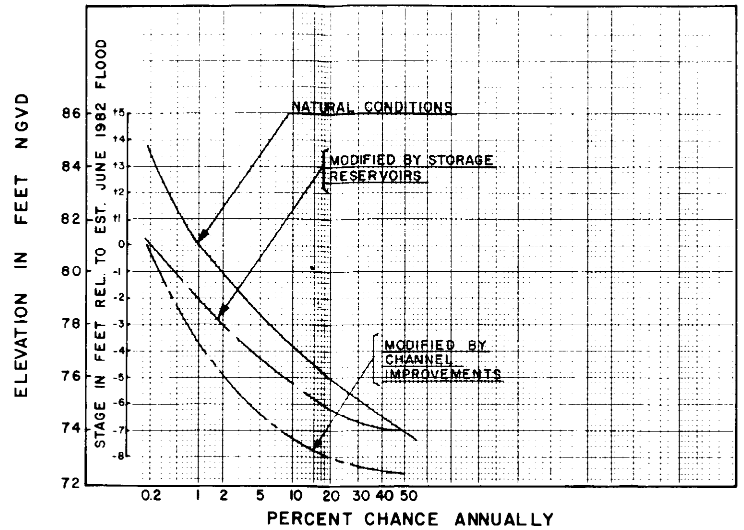
DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, DESIGN BRANCH
REVIEWED:
PROJECT MANAGER HYDRO. ENG. SECT.
APPROVAL RECOMMENDED: APPROVED DATE
CHIEF, PROJECT MNGT. BRANCH CHIEF, ENGINEERING DIVISION
SCALE SPEC. NO.
DRAWING NUMBER
SHEET



INDEX STATION NO. 6A

1500± FT. UPSTREAM ORANGE / MILFORD TOWNLINE

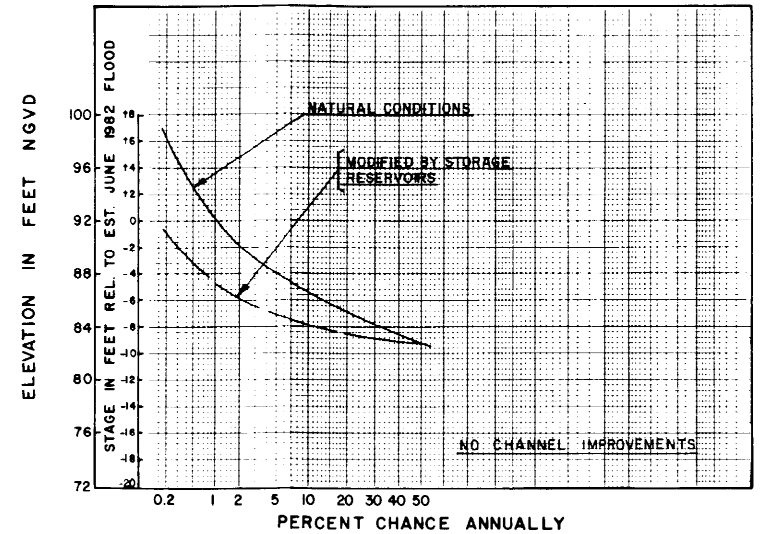
(D.A. = 15.0 SQ. MI.)



INDEX STATION NO. 6B

PRUDDEN LANE

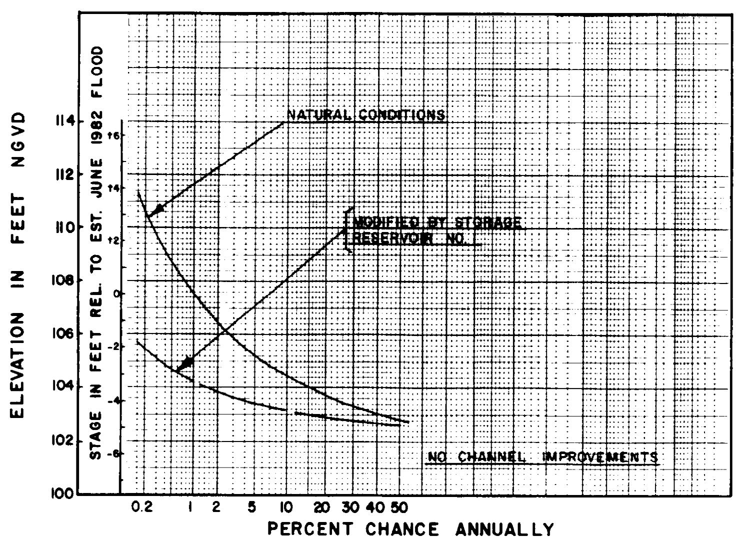
(D.A. = 15.0 SQ. MI.)



INDEX STATION NO. 7

100± FT. UPSTREAM OLD GRASSY HILL ROAD

(D.A. = 12.4 SQ. MI.)



INDEX STATION NO. 8

16,000± FT. UPSTREAM ORANGE/MILFORD TOWNLINE

(D.A. = 8.0 SQ. MI.)

GRAPHIC SCALES

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY | DR. BY | CK. BY
SUBMITTED:
CHIEF, SECTION
APPROVAL RECOMMENDED:
CHIEF, DESIGN BRANCH
REVIEWED:
PROJECT MANAGER
APPROVAL RECOMMENDED:
CHIEF, PROJECT MNGT. BRANCH

WEPAWAUG RIVER BASIN
WEPAWAUG RIVER, CT.

STAGE FREQUENCY CURVES
TOWN OF ORANGE, CT.

HYDRO. ENG. SECT.

APPROVED DATE
CHIEF, ENGINEERING DIVISION

SCALE | SPEC. NO.
DRAWING NUMBER
SHEET

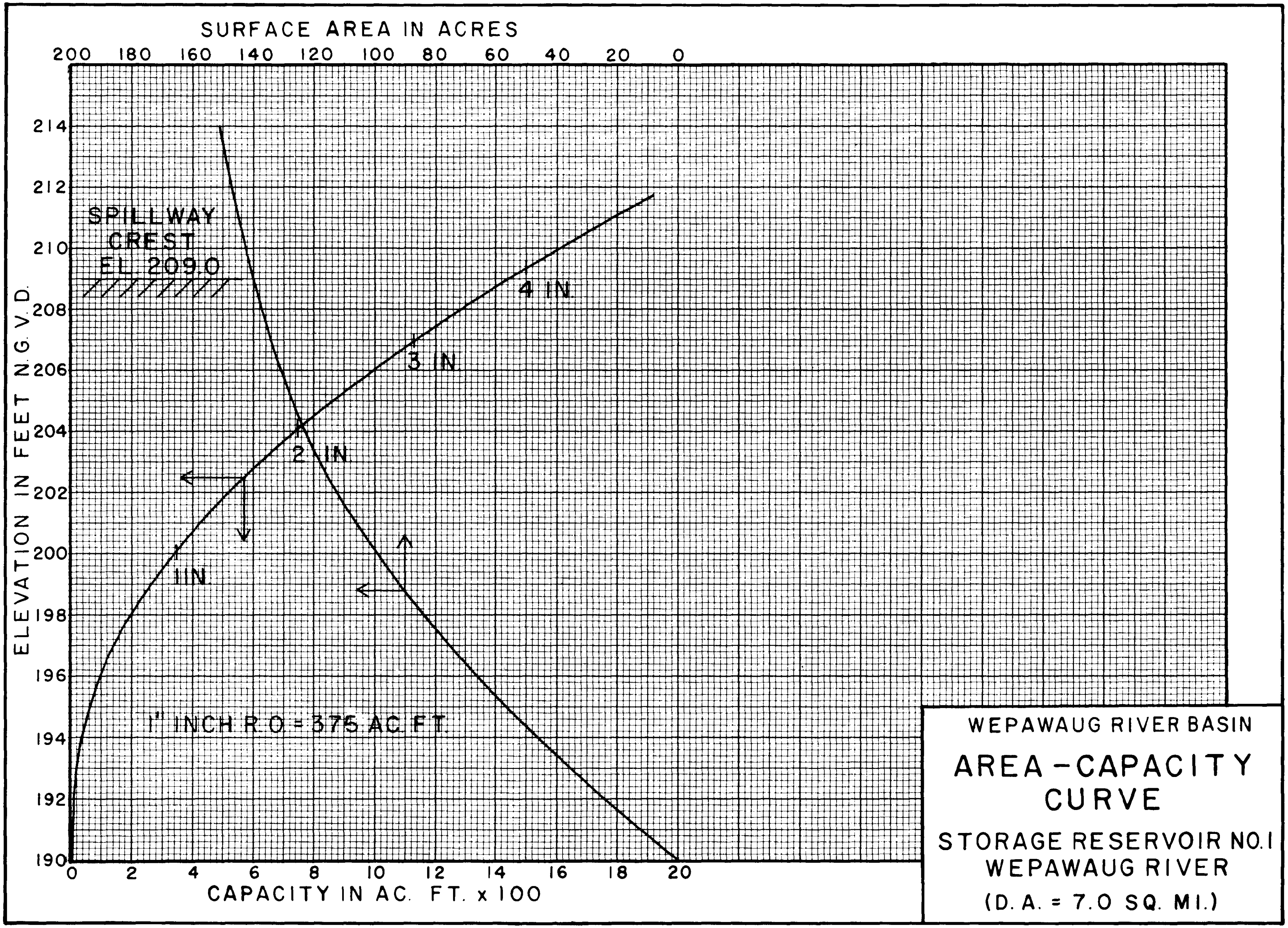
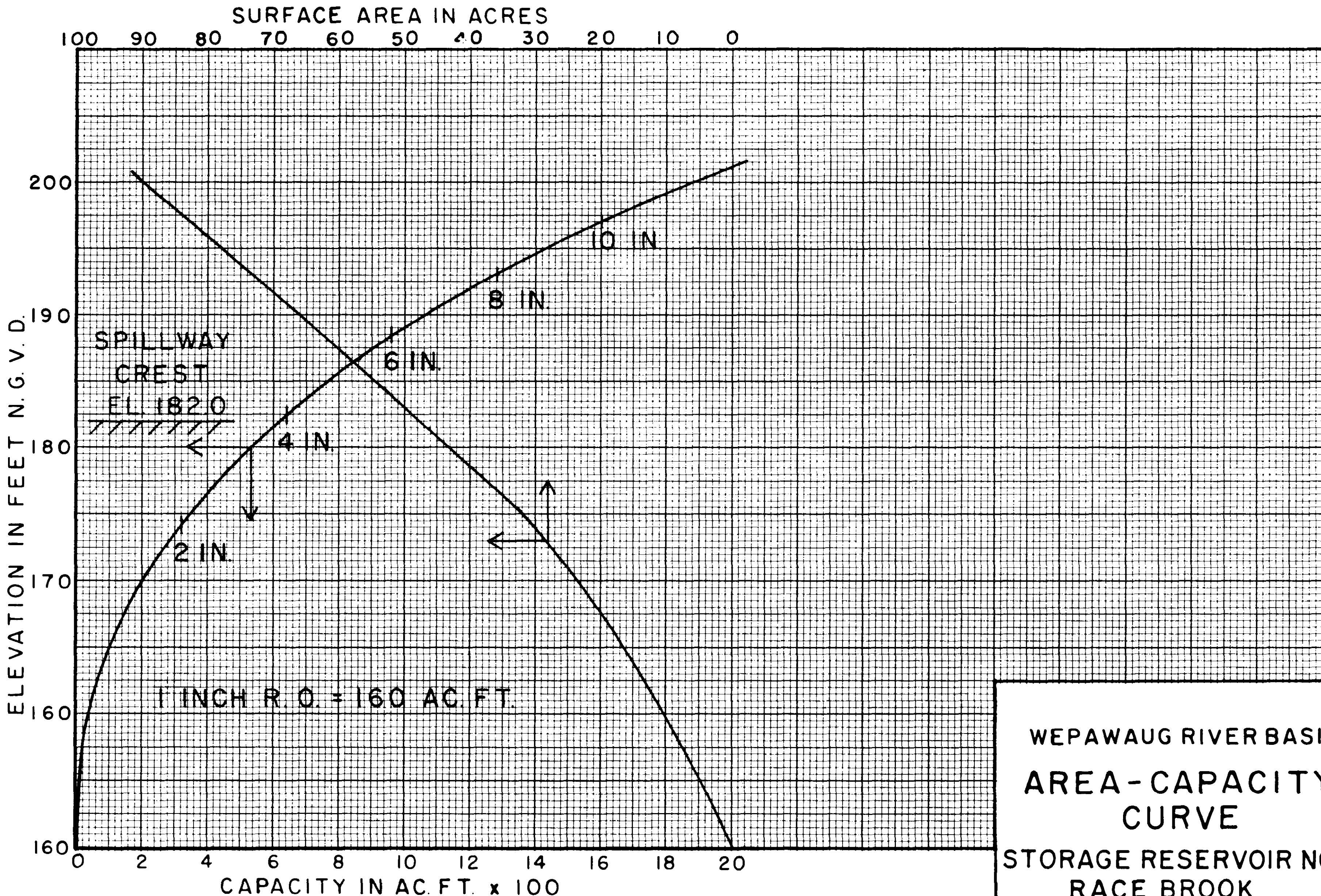

SURFACE AREA IN ACRES
200
180
160
140
120
100
80
60
40
20
0
214
212
210
208
206
204
202
200
198
196
194
192
190
ELEVATION IN FEET N.G.V.D.
SPILLWAY
CREST
EL. 209.0
4 IN.
3 IN.
2 IN.
1 IN.
1" INCH R.O. = 375 AC. FT.
0
2
4
6
8
10
12
14
16
18
20
CAPACITY IN AC. FT. x 100
WEPAWAUG RIVER BASIN
AREA-CAPACITY
CURVE
STORAGE RESERVOIR NO. 1
WEPAWAUG RIVER
(D. A. = 7.0 SQ. MI.)

PLATE 9



WEPAWAUG RIVER BASIN

AREA - CAPACITY CURVE

STORAGE RESERVOIR NO. 2
RACE BROOK
(D. A. = 3.0 SQ. MI.)

PLATE 10